DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Information Disclosure Statement

2. The information disclosure statement (IDS) submitted on **8/7/2006** is in compliance with the provisions of 37 CFR 1.97. Accordingly, the examiner has considered the information disclosure statements. The initialed and dated information disclosure statement (IDS) submitted on **8/7/2006** is attached to this Office action.

Drawings

3. The drawings are objected to because empty diagram boxes are impermissible under 37 CFR §1.83(a) which recites as follows:

> *"The drawing in a nonprovisional application must show every feature of the invention specified in the claims. However, conventional features disclosed in the description and claims, where their detailed illustration is not essential for a proper understanding of the invention, should be illustrated in the drawing in the form of a graphical drawing symbol or a **labeled** representation (e.g., a **labeled** rectangular box)." (Emphasis added by Examiner)*

The empty diagram boxes **58, 69, 74, 76**, found in **Figures 4** and **5** of the drawings, must be labeled with an appropriate descriptive phrase in addition to the reference characters all ready present. (i.e. **76= Reconstruction unit**, **74=composition unit; 69=control unit,** and **box 58 ? whatever is supposed to be, needs to be labeled and pointed out in the description of the specification**. Please see 37 CFR §1.84(n), 37 CFR §1.84(o), and 37 CFR §1.84(p) for more information on the difference between the required legends and the reference characters all ready present. Appropriate correction is required.

4. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure

is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either “Replacement Sheet” or “New Sheet” pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

5. The drawings are also objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description:

A) <u>The blank box identified as **reference character 58**, needs to be properly labeled as what it is, and a citation to reference number 58 **should be inserted in the appropriate location within applicants’ specification**</u>. Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) is required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either “Replacement Sheet” or “New Sheet” pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

> invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

8. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. **Claims 1-22** are rejected under 35 U.S.C. 103(**a**) as being unpatentable over **Griswold et al.**, US patent application publication **2005/0264287 A1** published December 1, 2005, filed May 11, 2005.

Claims

10. With respect to **Claim 1**, **Griswold et al.**, **2005/0264287 A1** teaches and shows" A magnetic resonance imaging method wherein magnetic resonance signals are acquired by means of a receiver antennae system via a plurality of signal channels" [see figures 1, 2 with respect to the four different antenna antennas which have corresponding channels 12.1, 12.2, 12.3, 12.4] “which receiver antennae system has a sensitivity profile” [see paragraph [0022]] the magnetic resonance signals are acquired with under sampling for respective orientated sector shaped regions in k-space”[see the

abstract and paragraph [0007] through [0032]], “regularly re-sampled magnetic resonance signals are re-sampled on a regular sampling grid from the undersampled acquired magnetic resonance signals”[see figures 2 through 6, and the teachings of paragraph [0007] through [0033]] “the re-sampling involving convolution of the undersampled acquired magnetic resonance signals by a gridding kernel” (i.e. See the re-gridding procedure of **Griswold et al.**, which accomplishes the principle of convolution, with a smaller sub-sample of data [See figures 2 through 6, and paragraphs [0023] through [0034]] serving the same purpose as applicant's “gridding Kernel”.] which also depends on the orientation of the sector shaped region at issue” [see figures 2 through 6] “and the sensitivity profile of the receiver antennae system” [See paragraph [0022], and antennas 12.1, 12.2, 12 .3, 12 .4, of figures 1 and 2] “and “a magnetic resonance image is reconstructed from the re-sampled magnetic resonance signals’ [See paragraph [0022], [0033]]

11. The examiner notes that, the **Griswold et al**., reference lacks directly stating that a “convolution” is being performed. However, it would have been obvious to one of ordinary skill in the art at the time that the invention was made that the method of the **Griswold et al**., reference is employing a type of convolution, even though the terms “convolution" or “convolving” are not explicitly stated. Therefore, the feature of convolution is considered to be an implicit and intrinsic part of the **Griswold et al**., reference.

12. With respect to **Claim 2**, **Griswold et al**., **2005/0264287 A1** teaches and shows "the magnetic resonance signals are acquired by scanning k-space along a non-linear, in particular spiral shaped, trajectory” [See the abstract, figures 2, 3, 4, and the teachings of paragraphs [0007 [through [0033]]. The same reasons for rejection, and obviousness, which apply to **claim 1** also apply to **claim 2** and need not be reiterated. .

13. With respect to **Claim 3**, **Griswold et al**., **2005/0264287 A1** teaches and shows “a magnetic resonance image is derived from sub-sampled magnetic resonance signals and on the basis of the spatial sensitivity profiles of a plurality of receiving antennae” see figures 1, 2, paragraph [0022], antenna components 12.1, 12.2, 12 .3, 12 .4, of figures 1 and 2] “a sequence of RF-pulses and gradients is applied” [See paragraph

[0020], [0021]], which sequence corresponds to a set of trajectories comprising at least one substantially non-linear trajectory in k-space, wherein the sampling density of said trajectory set being substantially lower than the normal sampling density corresponding to the object size, each signal along said trajectory set is sampled at least at two different receiver antenna positions, resulting into a plurality of receiver-antenna signals, the image is reconstructed by converting the data of said signals from said trajectory set to a Cartesian grid" [See the abstract, figures 1 through 6 and the teachings of paragraph [0002] through [0033]. The examiner notes that the step of "convolution with a gridding kernel" is not verbatim recited in words, within the, **Griswold et al.**, reference. However, as noted above in the rejection of claim 1 it would have been obvious to one of ordinary skill in the art at the time that the invention was made that the method of the **Griswold et al.**, reference is employing a type of convolution, even though the terms "convolution" or "convolving" are not explicitly stated. See the abstract, figures 1 through 6 and the teachings of paragraph [0002] through [0033]] "whereby the "gridding kernel" (i.e. the re-gridding process shown by figures 3-6] "is a Fourier-transform of a pattern" [See paragraph [0033] "weighted for each antenna with respect to the Cartesian grid, and the gridding kernel pattern differs between one region and another in k-space" [See the Archimedean spiral from which the re-gridding is originally defined, from figures 2 through 6] The same reasons for rejection, and obviousness, which apply to **claim 1** also apply to **claim 3**and need not be reiterated. .

14. With respect to **Claim 4**, **Griswold et al.**, **2005/0264287 A1** teaches and shows the weighting pattern is obtained in that for every individual region of k-space, a set of parallel equidistant lines is assigned" See figure 3], "which lines locally match said trajectory set, a pattern of overlapping points in image space is determined, which corresponds to the set of parallel equidistant lines in k-space, in image space, the weighting pattern per antenna is calculated, which pattern approximately corresponds to a pattern solely of said parallel equidistant lines in the individual region of k-space.' [See the teachings of paragraph [0007] [0033], with the abstract and figures 1 through 6.] The same reasons for rejection, and obviousness, which apply to **claim 1** also apply to **claim 4** and need not be reiterated. .

15. With respect to **Claim 5, Griswold et al., 2005/0264287 A1** teaches and shows from figures 2, 3, and 4 that "at least part of the trajectory set corresponds to an Archimedic spiral and the regions in k-space are defined by their azimuthal angle in k-space." [See paragraph [0023] through [0033]] The same reasons for rejection, and obviousness, which apply to **claims 1, 2** also apply to **claim 4** and need not be reiterated. .

16. With respect to **Claim 6**, **Griswold et al.**, **2005/0264287 A1** shows "the weighting pattern of the antenna is calculated according to the inversion of a Cartesian set of equations for the sub-sampled data and the spatial sensitivity profiles of the receiving antennae. [See the 1/FOV and 2/FOV etc for each of the spiral trajectories of figure 3, and the regridding procedure of figures 4 through 6. [See paragraphs [0023] through [0033]] The same reasons for rejection, and obviousness, which apply to **claims 1, 2, 4** also apply to **claim 6** and need not be reiterated. .

17. With respect to **Claim 7**, and **corresponding claim 20,** which respectively depend from independent c**laims of 1** and **16**, **Griswold et al.**, lacks directly teaching a mathematical inversion equation, as mathematically set forth by the applicant, in **claim 7** and corresponding **claim 19**, however **Griswold et al**., does teach: a reconstruction matrix [See figures 2-6 and paragraphs [0023] through [0033]] spatial sensitivity profiles of the antennas12.1, 12.2, 12.3, and 12,4 that have the data points which can overlap, as shown in figures 3 and 4; it is well known that all RF antennas have a noise covariance between the antenna components, therefore this feature is considered to be intrinsic to the antenna components of the **Griswold et al**., reference. A regularization matrix, suggestive of a permission conjugate is also, shown with respect to the regridding procedure, which encompasses figures 2,3,4,5 and 6. [See the **Griswold et al**., abstract, paragraph [0001].through paragraph [0034], as well as figures 1 through 6.] Therefore, it would have been obvious to one of ordinary skill in the art at the time that the invention was made that the limitations and aspects of corresponding claims 7, 20, fall within the scope of the applied **Griswold et al.**, reference, even though the exact mathematical formulation of applicant's equation is absent. The same reasons for

rejection, and obviousness, which apply to **claim 1, 2, 4, 6, 16, 17, 18,** and **19** also apply to **claims 7, 20** and need not be reiterated. .

18. With respect to **Claim 8 Griswold et al., 2005/0264287 A1** teaches and shows "the gridding kernel is chosen to correspond to a larger FOV" (i.e. in figure 1, and in figure 2, the antenna coils 12.1, 12.2, 12 three and 12.4, are shown to surround the sample being imaged. (i.e. Reference component number 7) "as the normal FOV covering the size of the object to be studied" [See figures 1, 2] "and the values of the regularization matrix R" [See figures 2, 5,6] "between the margin of the larger FOV and the normal FOV are set to zero. [See the missing blank data shown in figure 5] The same reasons for rejection, and obviousness, which apply to **claim 1, 2, 4, 6, 7** also apply to **claim 8** and need not be reiterated. .

19. With respect to **Claim 9 Griswold et al., 2005/0264287 A1** teaches and shows, "a tapering window function" (i.e. the Archimedean spiral, taught and shown throughout the reference) "or the sum of squares of sensitivities of each antenna. [See paragraph [0022]] The same reasons for rejection, and obviousness, which apply to **claim 1, 2, 4, 6, 7, 8,** also apply to **claim 9** and need not be reiterated. .

20. With respect to **Claim 10 Griswold et al., 2005/0264287 A1** teaches and shows "the gridding kernel functions between the two nearest radii traversing the spiral trajectory set are interpolated" onto individual projection lines. [See figures 3 through 6, and paragraphs [0023] through paragraph [0033]] The same reasons for rejection, and obviousness, which apply to **claim 1, 2, 5,** also apply to **claim 10** and need not be reiterated. .

21. With respect to **Claim 11 Griswold et al., 2005/0264287 A1** teaches and shows "both radii are gridded and the result thereof is interpolated. [See figures 5 and 6, and paragraphs [0023] through paragraph [0033]]] The same reasons for rejection, and obviousness, which apply to **claims 1, 2, 5, 10,** also apply to **claim 11** and need not be reiterated. .

22. With respect to **Claim 12**, **Griswold et al., 2005/0264287 A1** teaches and shows that "the most central region of k-space is reconstructed at full sampling density by direct inversion and the result of the gridding reconstruction method is blended with the

result of the reconstruction at full sampling density. [See the teachings of paragraphs [0027] through [0033]] The same reasons for rejection, and obviousness, which apply to **claim 1,** also apply to **claim 12** and need not be reiterated. .

23. . With respect to **Claim 13, Griswold et al., 2005/0264287 A1** teaches and shows that “the gridding kernel pattern for each antenna derived from the reconstruction matrix A, is divided into a defined number of sub-functions” [See figures 2, 3, 4 5 and 6], “for which the support of the corresponding functions in k-space tends to zero” [See figure 5], “in order to discard sharp transitions in the gridding kernel pattern” (i.e. a constant velocity Archimedean spiral is specifically designed to have a constant transition), “whereas each sub-function” [See figure 2] “is gridded separately”. The same reasons for rejection, and obviousness, which apply to **claims 1, 2, 4, 6, 7** also apply to **claim 13** and need not be reiterated. .

24. . With respect to **Claim 14, Griswold et al., 2005/0264287 A1** teaches and shows that “sets of samples assigned to adjacent radii are gridded and transformed separately. [See **figures 2-6** and the teachings of paragraphs [0023] through [0033]] The same reasons for rejection, and obviousness, which apply to **claim 1, 2, 5, 10,** also apply to **claim 14** and need not be reiterated. .

25. With respect to **Claim 15, Griswold et al., 2005/0264287 A1** teaches and shows Use of the image generated by the method as claimed in claim 1, in order to initialize a conventional iterative algorithm for reconstruction of the image. [See paragraphs [0007] through [0033], and figures 2 through 6] The same reasons for rejection, and obviousness, which apply to **claim 1,** also apply to **claim 15** and need not be reiterated.

26. With respect to **Claim 16**, and the **corresponding computer implementation claim 21, Griswold et al**., **2005/0264287 A1** teaches and shows “A magnetic resonance imaging apparatus for obtaining an MR image from a plurality of signals comprising: a main magnet, (6) :a transmitter antenna for excitation of spins in a predetermined area of the patient (i.e. component 12 which is comprised of” “a plurality of receiver antennae for sampling signals in a restricted homogeneity region of the main magnet field” [See antenna 12.1, 12.2, 12.3, 12.4].

27. The Examiner notes that, the **Griswold et al.,** reference does not illustrate the "table for bearing a patient, or the means for continuously moving the table through the bore of the main magnet, which are aspects of conventional magnetic resonance system apparatuses, however It would have been obvious to one of ordinary skill in the art at the time that the invention was made that a human patient is represented by the circle referenced as components 7 representing the subject / person / object in the main MRI system of figure 1, and that traditionally a patient is located on a patient table within the MRI system and the patient table traditionally has the capability of moving, in order to bring the patient into and out of the MRI system therefore, these components are considered to be an intrinsic part of the **Griswold et al.,** reference, by the Examiner; and would have been readily apparent to one of ordinary skill in the art, at the time that the invention was made.

28. Additionally with respect to the limitations of, a "means for deriving a magnetic resonance image from sub-sampled magnetic resonance signals and on the basis of the spatial sensitivity profile of each of said receiving antenna positions, means for applying a sequence of RE-pulses and gradients, which sequence corresponds to a set of trajectories comprising at least one substantially non-linear trajectory in k-space, wherein the density of said trajectory set being substantially lower than the density corresponding to the object size, means for sampling each signal along said trajectory set at least at two different receiver antenna positions, resulting into a plurality of receiver-antenna signals, means for reconstructing the image by converting the data of said signals from said trajectory set to a Cartesian grid by convolution with a gridding kernel, and whereby the gridding kernel is specific for each antenna, the gridding kernel pattern differs between one region and another in k-space, and the gridding kernel is a Fourier-transform of a pattern weighted for each antenna with respect to the Cartesian grid" which correspond to limitations of claim 1, the same reasons for rejection and obviousness that apply to claim one also apply to claim 16 and need not be reiterated. [See the abstract, figures 1 through 6, and paragraphs [0001] through [0034]]

29. With respect to **Claim 17, Griswold et al., 2005/0264287 A1** teaches and shows a "means for obtaining the weighting pattern including means for assigning, to every

individual region of k-space, a set of parallel equidistant lines, which lines locally match said trajectory set, means for determining a pattern of overlapping points in image space, which corresponds to the set of parallel equidistant lines in k-space, and means for calculating, in image space, the weighting pattern per antenna, which pattern approximately corresponds to a pattern solely of said parallel equidistant lines in the individual region of k-space. [See the abstract, the apparatus of figure 1 and the procedure defined by figures 2 through 6, as well as the paragraphs [0001] through [0034]] The same reasons for rejection, and obviousness, which apply to **claim 1,** also apply to **claim 17** and need not be reiterated. .

. With respect to **Claim 18**, **Griswold et al.**, **2005/0264287 A1** teaches and shows a "means for defining the regions in k-space by their azimuthal angle in k-space, whereas at least part of the trajectory set corresponds to equidistant spirals. . [See control processor 22; figures 1 through 6, and paragraphs [0023] through [0033]] The same reasons for rejection, and obviousness, which apply to **claim 1, 16, 17,** also apply to **claim 18** and need not be reiterated. .

30. With respect to **Claim 19**, **Griswold et al.**, **2005/0264287 A1** teaches and shows a means for calculating the weighting pattern of the antenna according to the inversion of a Cartesian set of equations for the sub-sampled data and the spatial sensitivity profiles of the receiving antennae. . [See control processor 22;] The same reasons for rejection, and obviousness, which apply to **claim 1, 16, 17,** also apply to **claim 19** and need not be reiterated.

31. **Claims 1-21 are** also rejected under 35 U.S.C. 103(**a**) as being unpatentable over **Griswold et al**., US patent 7,132,827 B2 issued November 7, 2006, filed May 11, 2005 which corresponds **Griswold et al.**, US patent application publication **2005/0264287 A1**, applied above, therefore in the interest of compact prosecution a second recitation of the claims is considered redundant and Unnecessary. Now

Conclusion

32. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tiffany Fetzner whose telephone number is: (571) 272-2241. The examiner can normally be reached on Monday, Wednesday, and Friday-

Thursday from 7:00am to 2:10 pm., and on Tuesday and Thursday from 7:00am to 5:30pm.

33. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, **Diego Gutierrez,** can be reached at (571) 272-2245. The **only official fax phone number** for the organization where this application or proceeding is assigned is **(571) 273-8300**.

34. Information regarding the status of an application may be obtained from the Patent Application information Retrieval (PAIR) system Status information for published applications may be obtained from either Private PMR or Public PMR. Status information for unpublished applications is available through Private PMR only. For more information about the PMR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PMR system contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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